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FARMERS' BULLETIN No. 1401

MANAGING
CRANBERRY
FIELDS



FARMERS' BULLETIN 1400, Establishing Cranberry Fields, discusses many principles involved in cranberry growing and gives directions for establishing cranberry fields.

This bulletin discusses the management of established cranberry fields. This involves winter, summer, and fall flooding for winter protection, the control of insects and diseases, and the protection of the crop from frost injury. Methods of controlling weeds are discussed and many weeds illustrated.

The third bulletin of this series is Farmers' Bulletin 1402, Cranberry Harvesting and Handling.

Other bulletins which should be read in conjunction with this series are Farmers' Bulletin 860, Cranberry Insect Problems and Suggestions for Solving Them, and Farmers' Bulletin 1081, Cranberry Diseases and Their Control.

MANAGING CRANBERRY FIELDS.¹

GEORGE M. DARROW, *Pomologist, Office of Horticultural Investigations, Bureau of Plant Industry*; HENRY J. FRANKLIN, *Superintendent of the Cranberry Substation, Massachusetts Agricultural Experiment Station*; and O. G. MALDE, *formerly Superintendent, Wisconsin Cranberry Experiment Station*.

CONTENTS.

	Page.		Page.
Control of insects and diseases-----	1	Weeding-----	6
Resanding-----	2	Cleaning ditches and upland-----	15
Winter flooding-----	2	Pruning-----	16
Summer and fall flooding-----	3	Mowing and burning-----	16
Flooding and frost protection-----	3	Duration of a cranberry field-----	17
Weather forecasting-----	3	Seasonal operations in cranberry fields-----	17
Fertilizers-----	3		

MANAGING cranberry fields necessitates a knowledge of insect and disease control, flooding for protection against winter injury and frosts, weather forecasting, fertilizers, and weeding. Much of this knowledge can be gained only by experience, for the conditions surrounding cranberry fields are extremely variable. Details regarding each operation will therefore be varied to suit local needs.

CONTROL OF INSECTS AND DISEASES.

The cranberry is subject to several serious insect pests. These pests are most harmful on fields without proper water supplies for flooding and affect the foliage, fruit, vines, and root. Farmers' Bulletin No. 860, *Cranberry Insect Problems and Suggestions for Solving Them*, gives brief descriptions of these pests, their life histories, and the means found most effective in controlling them. The bulletin mentioned states:

An abundant water supply, permitting flooding and reflooding at the proper times, is the best remedy for insect injury in cranberry bogs, and when the sites of new bogs are to be chosen this should always be borne in mind. On cranberry land where the water supply is insufficient, however, spraying, sanding, and other measures will have to be used.

Farmers' Bulletin No. 1081, *Cranberry Diseases and Their Control*, gives information on the diseases of the cranberry. The bulletin states that there are numerous diseases which affect the cranberry and that they are gradually spreading and becoming more serious. Every field differs from every other one, and conditions vary even in different parts of the same field. Experience, careful

¹ In Massachusetts and New Jersey the name "bog" is commonly applied to areas planted to cranberries, though very small areas are referred to as "yards." In Wisconsin the word "marsh" is used in place of "bog." The words "bog" and "marsh" both refer to swampy ground. The popular conception of a bog or marsh is a swamp where mosquitoes breed, a nuisance in any neighborhood. Neither term, then, is fitly applied to a developed well-drained cranberry property. To apply a term in keeping with modern methods of raising cranberries, the term "field" is used in this bulletin, and a properly drained area planted to cranberries is called a "cranberry field."

observation, and study must determine the most satisfactory methods of handling a particular field in order to obtain the most vigorous and productive vines.

There is evidence that spraying with Bordeaux mixture results in an accumulative injury on sanded areas in Massachusetts. This fungicide is not recommended for indiscriminate use on fields in that State.

RESANDING.

The use of sand on cranberry fields was discussed in *Farmers' Bulletin No. 1400, Establishing Cranberry Fields*. From 2 to 3 inches of sand to be applied before planting was recommended for certain regions and also resanding with one-fourth to one-third of an inch of sand every year until the field came into full bearing to thoroughly root all runners.

After the field has come into full bearing it should be resanded every second or third year with one-third to one-half inch of sand. This resanding encourages the runners to root, covers debris, helps in the control of certain insects, and aids in preventing frosts.

WINTER FLOODING.

Without protection the cranberry vine will not always endure the winters in the regions where it is grown, except on the Pacific coast. In the wild it grows mainly along streams and in swamps where the water rises in winter and covers and protects it. Growers have found it necessary to give similar protection to the plants during the winter. Wherever possible, cranberry fields receive winter protection by the use of water, called "winter flooding." In Massachusetts and New Jersey some fields can not be flooded during the winter. They are considered much less valuable than those which can be flooded, as they are liable to such severe injury in winter that all prospects for a crop may be destroyed.

Winter flooding can not be applied by the calendar. It should be done in the fall or early winter, but as late as possible without serious risk of injury from winterkilling. It should not be delayed after the soil in the field to be flooded has frozen 2 or 3 inches deep. This seldom occurs in New Jersey and Massachusetts before December, and sometimes not before January. In Wisconsin flooding is sometimes necessary in late October on new plantings, but not generally until November or early December on old fields.

On some fields the winter water is kept just deep enough to cover the vines, which freeze into the ice. On others it is kept at a depth of several feet. In general, a depth of from 1 to 2 feet is probably best.

During the winter the dikes and flumes should be inspected from time to time, especially during thaws. Some fields, notably those flooded by pumping, must be given additional water several times to maintain the desired level, for if the water is raised or lowered when ice covers the field the ice may break and shift, tearing up the vines.

The water ordinarily should be drained off by April 1 in New Jersey and Massachusetts, but if necessary it may be left on until the middle of May. In Wisconsin the water is removed in April

or early May, but the fields are reflooded if injurious temperatures threaten later.

Winter flooding is not generally practiced on the Pacific coast.

SUMMER AND FALL FLOODING.

Cranberry fields are reflooded from time to time after the winter flood is drained off and before the vines blossom. Reflooding has been found the most effective and most economical means of protection against frost injury and of controlling some insects. It is also done occasionally by some growers to control weeds and diseases, and water is sometimes needed in dry weather for irrigation.

Injudicious flooding, however, may injure the vines and destroy the crop. The cranberry vine, like all plants, uses oxygen in respiration. Water contains varying amounts of oxygen which the cranberry can use. Dark-colored water from swamps and water from reservoirs and ponds with mud bottoms contains less oxygen than that from clear streams and from ponds with sandy or gravelly bottoms.

In winter and in cool weather the respiration of plants is slow and little oxygen is used by the cranberry. In warm weather, when the vines are growing rapidly, respiration is much more rapid. The water used for flooding may then contain too little oxygen for the plants, and they may smother if submerged too long. On bright, sunny days cranberry vines give off more oxygen than they use, and there is less danger in flooding them than when the days are cloudy. On warm cloudy days the vines give off little or no oxygen, but by respiration use up that contained in the water, and their more tender parts, including the blossom buds, are very likely to smother unless the flooding period is brief.

Vines in bloom must never be flooded, and reflowing should not be done after the berries have set and begun to grow, unless the fruit worm or girdler is doing great harm. Flooding the young berries sets up an infection of putrefactive fungi which impairs their keeping quality.

In Massachusetts, if the fruit worm or the girdler has been active, the crop should be gathered by September 25 and the field promptly flooded for a period of two weeks. The vines are maturing by this time and will endure this prolonged submergence without danger. In New Jersey there are fewer fruit worms than in Massachusetts, and one week of flooding is enough. Fall flooding is advisable as a regular preventive against these pests.

FLOODING AND FROST PROTECTION.

"Damaging frosts invariably occur in Wisconsin in the month [of May], often in June, rarely in July, occasionally in August, and invariably again in the month of September; while midsummer frosts are unknown in the East and seldom occur in the month of June."² Although damaging frosts are more frequent in Wisconsin than in New Jersey and Massachusetts, yet some frost protection is needed nearly every year in both the latter States.

²Cox, Henry J. Frost and temperature conditions in the cranberry marshes of Wisconsin. U. S. Dept. Agr., Weather Bur. Bul. T, 121 p., 31 fig. 1910.

Cranberry fields after growth starts withstand without injury temperatures as low as 29° F. In the spring the winter buds of the cranberry will endure a temperature of 25° F., even after they have begun to swell. Later, when the tender new growth has started, frosts with minimum temperatures below 29° F. are always dangerous. When the berries turn greenish white just before ripening, a temperature of 27° F. will cause no injury, but one of 24° F. will harm them if long continued.

When ripe, Early Black and Howes cranberries begin to freeze at or slightly above 22° F., but no softening of the fruit occurs following exposure to a temperature of 23° F. Ripe Howes berries are so resistant to frost that under field conditions often only 10 per cent of the fruit freezes at a temperature of 16° F. and only 20 per cent at 14° F. Sometimes, however, 25 per cent is softened if exposed to a temperature of 18° F. The Early Black variety is less resistant to these low temperatures than the Howes.

The value of sand as a means of frost protection was discussed in Farmers' Bulletin No. 1400, Establishing Cranberry Fields, in connection with sanding. Briefly, the sand covering of a field radiates its heat at night, thus giving considerable protection against frost. In Wisconsin the minimum temperature on cold summer nights among vines on sanded areas will average 6 degrees higher than among vines on peat. Frosts often form on peat fields when none occurs on near-by sanded areas. For example, for eight seasons at the Wisconsin Cranberry Experiment Station no frost protection was found necessary on sanded areas between May 10 and September 20, while severe frosts occurred on unsanded fields during this period.

When the growth of vines is rank the soil is screened from the sun and is warmed less during the day than when the growth is less dense. Such areas are more liable to frosts than are those less densely covered. Moreover, leaves, weeds, grasses, moss, and decaying vegetation are very poor conductors of heat. The soil of fields that are not kept resanded is covered with decaying leaves and other material, and such fields are more often frosted than well-sanded ones.

Air drainage is often very important in frost protection. Cold air is heavier than warm air, and if there is no wind it naturally settles into low areas, such as those occupied by cranberry fields. Because of this, frost may occur there when none forms on the adjacent upland.

A field surrounded by brush and high trees is more frosty than one in the open where slight breezes can stir the air. Wherever possible, therefore, the surrounding land should be cleared for some distance from the edge of the field. If the air circulates freely frost will not occur until the entire air temperature is below freezing. The water drainage outlet must be lower than the cranberry field, and frequently much can be done to prevent frost by cutting all undergrowth and trees along this outlet for a considerable distance. Cold air can then flow away and lessen the danger of frost.

After all possible frost protection has been given cranberry fields by sanding and by facilitating air movement, summer flooding may be resorted to when necessary. Many growers have a limited supply of water and must conserve it carefully. Most growers wish to flood for frost as little as possible, either because they feel that flooding

does some harm, or because they may need the water to control insects, or because flooding in the fall interferes with picking.

It rarely is necessary to cover the vines entirely in flooding for frost. A depth of 1 to 3 inches of water over the sand is enough for this protection except in very severe frosts, as the water will warm the air enough by radiation to keep the vines from freezing.

WEATHER FORECASTING.

General knowledge of weather forecasting is very helpful, and as far as possible the forecasting methods of the United States Weather Bureau should be understood.

The Weather Bureau has established a special service for cranberry growing during periods when frosts are likely to occur. This service consists of—

Daily weather maps, available to all applying for them.

Special warnings by wire from the district office nearest each cranberry-growing region, given during danger periods when severe frosts are expected. These are valuable, but as the forecasts are made 15 to 21 hours before the lowest temperatures occur and as unforeseen changes often occur during this time, supplementary service has been developed.

The cranberry substation of the Massachusetts Agricultural Experiment Station at East Wareham, Mass., is in touch with the district Weather Bureau office at Boston and is equipped with all necessary weather instruments. Forecasts during danger periods can be secured by growers from this office at any time of the day or evening. Because the predictions are made at a time so near the danger period, few unforeseen changes occur, and the forecasts are thus more dependable than those made early in the day.

Each cranberry grower should possess several accurate registering minimum thermometers and by their use determine what parts of his field are the coldest; after which the instruments should be kept in those locations, being placed among the vines about 4 inches above the ground.

If the sky is cloudy no frost will occur in late spring and early fall, even though other conditions favor it. It should not be taken for granted, however, in case it is cloudy in the early evening that it will remain so through the night. The clouds may suddenly clear away, the temperature drop quickly, and a damaging frost occur. Under such conditions a watch should be kept throughout the night to flood for frost protection if necessary.

FERTILIZERS.

Most cultivated plants have root hairs which take up both water and plant foods in solution from the soil. The cranberry plant has no root hairs but a mass of fibrous rootlets through which it must secure water and plant foods; but it is evident that this must be done in a manner different from that of ordinary crop plants. It is thought that certain fungi called "mycorrhiza," associated with the roots, have some function connected with the nutrition of the vines.

At present it is only by making tests of different fertilizers on each field that the plant-food needs of the soil can be determined, and until the need has been proved no general use of fertilizers should be practiced. The application of fertilizers on most cran-

berry fields with deep peat bottoms is not advisable, for they generally fail to increase yields, and the nitrates hurt the keeping quality of the fruit. Certain fertilizers have increased the yields on fields with sand bottoms.

The following paragraphs state the little that is known of the response of the cranberry to fertilizers.

Experiments and experience seem to show that on deep peat areas plenty of nitrogen is available for the cranberry. Often, in fact, there is so much that it causes an excessive vine growth.

Stable manure is undesirable because it spreads weed seed and has other injurious effects.

Sulphate of ammonia has been found injurious to cranberries, probably because of the sulphur in it, and therefore it can not be used as a source of nitrogen. Pure sulphur will kill cranberries if applied in quantity. Sulphuric acid sprayed on one area to kill weeds so affected it that cranberries would not grow for at least six years.

Nitrate of soda applied to cranberry fields stimulates vine growth. On soils called "hard bottoms," which contain a small percentage of muck, it also tends to increase yields. It is doubtful whether any application of nitrate of soda should exceed 150 pounds to the acre, and such an application should be made only to hard-bottomed areas where careful tests indicate its value. Dried blood has also proved a valuable source of nitrogen. Slightly larger quantities are used than of nitrate of soda.

Acid phosphate has been found beneficial on hard bottoms. On such soils it stimulates a good vine growth and heavy fruit production. Raw rock phosphate, where it has been used in Wisconsin, has proved even better than acid phosphate. In that State it is commonly used on hard bottoms. Of acid phosphate 400 pounds or 1 to 1½ tons of raw rock phosphate per acre are commonly used. Muck soils are usually lacking in this plant-food constituent, but may not be benefited by applications of it. No appreciable benefit from its use over a period of years was secured on muck soils at the cranberry substation of the Massachusetts Agricultural Experiment Station.

Potash has not produced enough favorable results on any of the cranberry soils to warrant its use.

The New Jersey Agricultural Experiment Station has recommended the following mixture per acre for gray sand or savanna lands in that State, and considerable success has followed its use:

Sodium nitrate	75 pounds.
Dried blood	75 pounds.
Rock phosphate	300 pounds.
Sulphate of potash	50 pounds.

WEEDING.

Over a hundred species of weeds infest cranberry fields, including most plants that live on peat and lowland meadows, many being serious pests. The annual cost of weeding some fields reaches \$100 an acre, but \$5 to \$10 ought to do this work if the field is properly made in the first place and properly cared for until it comes into bearing.

The easiest way to control weeds on many fields is to keep them from becoming established. Field after field has been noted where

seed trees were standing along shores or dikes. In a circle extending from 50 to several hundred feet from such trees, seedlings could be seen which were costing many dollars each year to eradicate, besides damaging the cranberries. In one field, hundreds of young black-gum seedlings were near an old tree that could have been destroyed in a few minutes, and in other fields young cedars, birches, maples, and various trees have been seen covering large areas, while near by on the shore were a few or solitary seed-bearing trees. The upland for some distance back from cranberry fields should be kept clean.

Another way in which many growers could save much money now spent in weeding is by keeping shore ditches and ditches along dams clean, so as to prevent the spread of shrubby plants to the cranberry fields. Bayberry, huckleberry, blueberry, leatherleaf, aronia, willows, poison-ivy, greenbrier, swamp dewberry, and some other weeds often enter cranberry fields by means of stolons or rhizomes from surrounding uplands or dikes.

All annual or biennial grasses and weeds can be controlled easily by mowing just before their seed matures. If all infested fields are so mowed and the surrounding upland kept clean no trouble from these need be experienced.

Good drainage greatly discourages the growth of most weeds which infest cranberry fields, at the same time favoring the development of the cranberry, and a vigorous growth of vines will smother many weeds.

Some weeds can be killed by spraying with materials that will not injure the cranberry vines. Iron-sulphate spray, made by dissolving 100 pounds of iron sulphate in 50 gallons of water, is used in Wisconsin to kill ferns, wood moss, many sedges, and other weeds. Two to three applications of this material made 10 days to two weeks apart will kill the aboveground parts and finally the roots. Cranberry fields should not be sprayed when in bloom or when the terminal buds have just opened. To make the applications effective a strong pressure must be maintained when spraying. Only brass-lined spray pumps should be used for this purpose. In Massachusetts dry iron sulphate sifted around the roots of ferns will kill them, but in New Jersey this treatment has not proved effective.

Most "weed killers" contain sodium arsenite and are used for destroying all vegetation along paths, driveways, etc. Sodium arsenite will injure cranberry vines when used at a strength effective for weeds, and it is not recommended for general use in cranberry fields. However, if areas are very weedy it may pay better to spray with a weed killer and later replant than to scalp and replant.

Sulphuric acid is used by some growers to kill greenbrier and ferns. This acid also injures cranberry vines; therefore a copper can with a long narrow spout through which only a little acid can come at a time is used to apply it. Men go through infested fields with such cans, letting a few drops run down the stem of each weed. This must be repeated at intervals during the summer until all are killed.

Some weeds can be killed most readily by drowning. To do this the winter flooding must be continued till July 10 or 15. If the water is then drained off, the vines will grow and bud for the next year's cranberries, thus losing but one year's crop. By this treatment most

of the grasses and weeds are killed, though some survive and must be eradicated by other means.

In Wisconsin sedges and grasses are especially troublesome, and flooding is done to drown them out. To make the drowning more

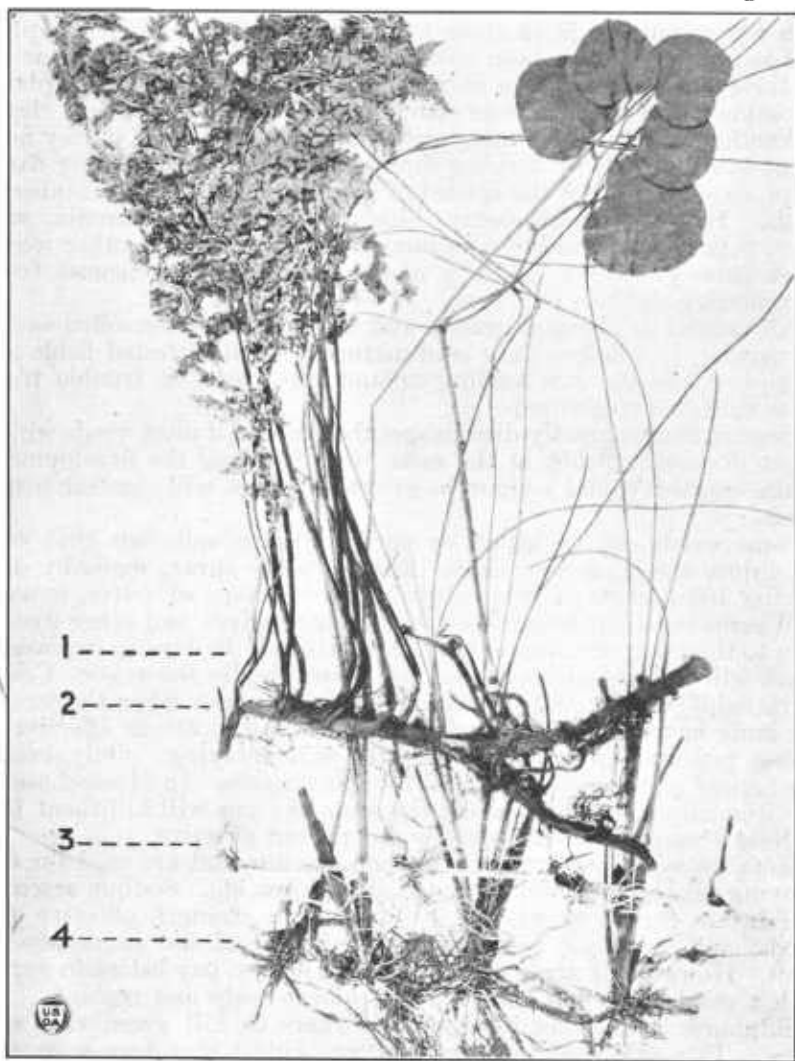


FIG. 1.—Weeds of cranberry fields. The illustration shows the position of weed roots in the soil. The surface of the soil line is represented at 1. The root of the chain fern (*Woodwardia virginica*), which occupies the same soil layer as the cranberry root is shown at 2. Weeds whose roots occupy this soil layer either crowd out the cranberry or are crowded out by it. The root of the greenbrier (*Smilax rotundifolia*) is shown at 3. It occupies the soil layer just below that occupied by the cranberry roots. The root of three-square (*Scirpus americanus*) is shown at 4. It occupies a still lower soil layer. All weeds whose roots occupy the soil layers below the cranberry root can crowd out the cranberry if their tops rise above the cranberry vines. They must be eradicated.

effective, the weeds are mowed while flooded, so that no tops may rise above the surface of the water. In some cases a shallow flood about 6 inches deep is held until July 10 to 15, and a roller is run over

the grasses at frequent intervals to break them over into the water and check their growth.

In general, there are three layers of weed roots in soils of cranberry fields, as illustrated by Figure 1. The root at the top is that of the fern, which occupies the same layer of soil as the cranberry



FIG. 2.—Weeding a cranberry field at East Wareham, Mass. Many weeds are pulled by the roots and carried off in baskets or boxes. Photographed June 21.

roots. Next below the root of the fern is shown that of the greenbrier, which grows in the layer of soil just below that which the cranberry roots occupy. When fields are badly infested with the greenbrier, so completely is the soil layer filled by its roots that it is even possible to roll up the turf by pulling on a mass of greenbrier



FIG. 3.—Weeding in a Wisconsin cranberry field.

roots. Below the roots of greenbrier are the roots of the three-square. All these plants can flourish on the same area, and all may infest the same part of a cranberry field.

Weeds with root systems in the same soil layer with the cranberry roots will finally crowd out the cranberry or be crowded out by it.

Ferns grow higher than the cranberry and shade it. If permitted to grow they finally weaken and crowd out the crop. Certain other weeds, such as the violet, have roots in the cranberry soil layer, but their tops are so low that they are shaded out by the cranberry vines. Ferns and other tall weeds, therefore, must be cleaned out, while no attention need be paid to the violet.

Most cranberry weeding is done in the manner illustrated in Figures 2 and 3. Men go over the whole field and grub out the weeds, using the tools shown in Figure 4. It is best each season to complete the weeding before the cranberry blossoms, but this is often impossi-

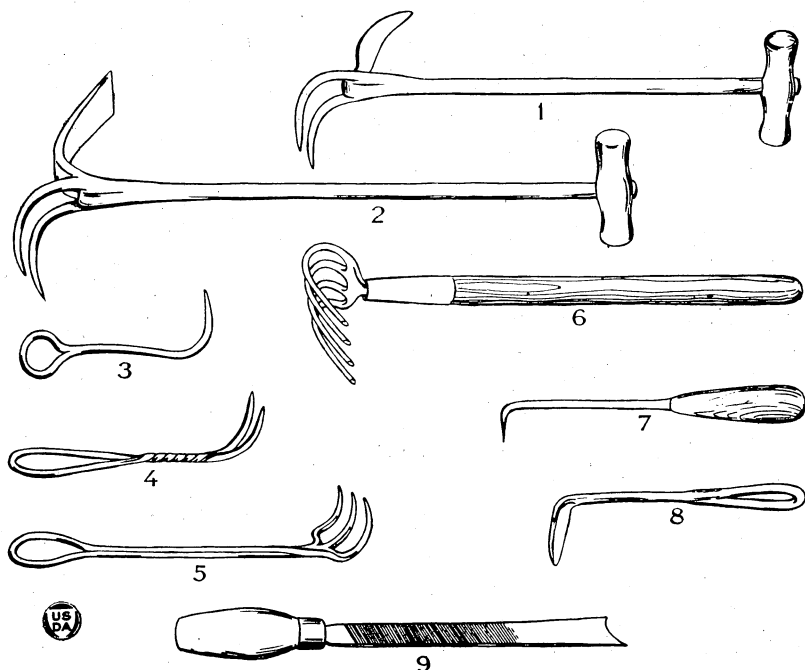


FIG. 4.—Types of hand weeders used in cranberry fields: 1, A 2-pronged weeder with a narrow-pointed blade on the side opposite the prongs; used in New Jersey. 2, A weeder similar to 1 except that the blade is flattened instead of being pointed; used in New Jersey. 3, A 1-pronged weeder or hook used on Long Island; preferred where the vines are thick and small weeds abound. 4 and 5, Weeders used on Long Island; preferred where the vines are not crowded close together and where large weeds occur. 6, A 4-tined weeder used where the weeds are large; Massachusetts. 7, A 1-pronged weeder or hook used in Wisconsin in cases where the vines are thick and small weeds are numerous. 8, A weeder with sharpened blade used in Massachusetts. 9, A weeder made from an old file; the end is sharpened and the edge curved to prevent weeds with hard stems from slipping off sideways; used in Wisconsin. These weeders vary in length from 8 or 10 inches to about 2 feet.

ble, and weeding is continued into midsummer. Weeding can not be economically done after harvesting, as the weeds are trampled down and it is not easy to separate them from the vines.

Brief comments on the nature and control of many of the more important weeds follow.

Algæ.—These form the growth commonly called "green scum." It is especially troublesome on fields where the winter flood is held late to control the fruit worm and other pests and in the flooding of the fields with numerous springs in the bottom. Suspending a sack containing copper sulphate in the water at the source of supply, as is done in controlling algæ in city water reservoirs, is suggested. Frequent changing of the flood water, where possible, helps to control this trouble.

Bayberry (*Myrica carolinensis*).—A well-known shrub bearing minute bony nuts. Rarely a weed except in New Jersey fields. Spreads as does the chokeberry and is controlled in the same way.

Birch (*Betula populifolia*).—A weed, chiefly in Massachusetts and New Jersey, where seed trees are allowed to grow on near-by upland. Cut out seedlings in fields. (Fig. 5.)

Chokeberry (*Aronia arbutifolia*, *A. melanocarpa*).—Shrubs bearing either scarlet, purplish, or black fruit. Rarely weeds in Wisconsin and Massachusetts, but common in New Jersey fields. Spreads by underground stems and by seeds. Seedlings easily rooted out when they first start, but difficult to eradicate later. Keeping border ditches well cleaned out will prevent the establishment of chokeberries along the edges of the field.

Clover (*Trifolium fibratum*).—A perennial clover sending out underground runners in all directions. It is found on the Pacific coast, and in that section is one of the worst weeds of cranberry fields. Underground stems may extend several feet before appearing above ground. This makes the work of digging it out especially difficult, as any piece left may start a new plant.

Dewberry, or running brier (*Rubus hispida* and its hybrids).—A swamp dewberry with very long canes which root at the tips. It is a serious weed in New Jersey, and often in Massachusetts and Wisconsin. It almost always spreads from adjoining upland into cranberry fields, but may easily be kept out by keeping border ditches clean. It is readily killed by holding the flood late in spring.

Ferns.—Several kinds of fern are common in cranberry fields and often become serious weeds. The chain fern, also called brake and bracken in New Jersey (*Woodwardia virginica*), shown in Figure 6, is the worst of all ferns. Its creeping rootstock grows in the same soil layer as the cranberry roots. In Massachusetts it is controlled by placing dry iron sulphate around the roots, and in New Jersey by the use of sulphuric acid. This fern grows much more rankly in New Jersey than in Massachusetts. In Wisconsin, spots densely covered with it may be trampled down and immediately



FIG. 5.—Weeds of cranberry fields. To the left a young birch, to the right a young cedar, both pulled from a cranberry field. The root systems of these trees occupy the soil layer below the cranberry root. These trees neither sucker nor have underground rootstocks and if pulled are killed. Seed trees of these species and others, such as black or sour gum and maples, along dams and borders should be cut to stop the seed from scattering to the cranberry field.

sprayed with iron-sulphate solution or dusted with the sulphate in the powdered form. In that State ferns may also be controlled by mowing regularly every two weeks for one or two seasons.

Bracken (*Pteridium latiusculum*, formerly known as *Pteris aquilina*).—Often troublesome on dry fields in Massachusetts. It yields to frequent mowing.

Five-leaf or yellow avens (*Geum strictum*).—This spreads by means of an underground rootstock much like the brakes, and its 5-parted leaves shade the cranberry vine. It is controlled in the same way as the bracken.

Grasses.—Many kinds of grasses are occasional weeds in cranberry fields, usually spreading by seed from the surrounding upland. Winter flooding is a sufficient control for most grasses. Rice cut-grass (*Homalocenchrus oryzoides*) among the grasses is the most common and persistent cranberry weed. Good drainage is its best control. The rattlesnake grass (*Panicularia canadensis*) is troublesome and grows rapidly, spreading from seed and underground rootstocks. Frequent mowing early in the season will check it. Spraying with iron-sulphate solution also helps to hold it in check in Wisconsin.

Greenbriers (*Smilax rotundifolia*, *Smilax glauca*).—These are also called cat briers or horse briers (fig. 7), and are among the most serious weeds of



FIG. 6.—Chain fern (*Woodwardia virginica*), one of the worst cranberry weeds in parts of New Jersey; also common in Massachusetts and Wisconsin. Its roots occupy the same layer of soil as the cranberry roots, and it spreads rapidly. In Massachusetts it is treated effectively by sifting dry iron sulphate around the bases of the plants. Treatment with sulphuric acid is considered necessary in New Jersey.

cranberry fields. They have a deep underground rootstock which may send up a stem at each node (joint), and in eradication every node must be taken out or they will grow again. Badly infested areas are commonly scalped, cleaned, and reset. Persistent use of sulphuric acid, as described on page 7, will eventually kill the plants.

Horsetails (*Equisetum* sp.).—The horsetails have perennial wide-spreading rootstocks. They sometimes infest cranberry fields and are hard to eradicate because of the great vitality of their rootstocks. In Wisconsin repeated spraying every 10 days with iron-sulphate solution has been effective in controlling this type of weed. In that State, after persisting for a few years, dense patches may disappear suddenly. If a new planting is much infested with horsetails it should be hoed over once a week regularly until the weeds are killed out and then be replanted. It is better to disregard it in old fields.

Leatherleaf or Cassandra (*Chamaedaphne calyculata*).—A low shrub controlled by grubbing.

Mosses.—Sphagnum moss is not serious except on fields kept too wet. Such fields should be better drained. In Wisconsin 10 pounds of quicklime in 50 gallons of water sprayed twice during the growing season will control this moss on wet fields. Wood moss also is rarely a serious weed except on wet areas in Wisconsin. There it may be controlled by three applications, made 10 days apart, of a salt spray consisting of 1 pound of salt to 3 gallons of water, or by covering with sand, or by spraying with iron-sulphate solution shortly

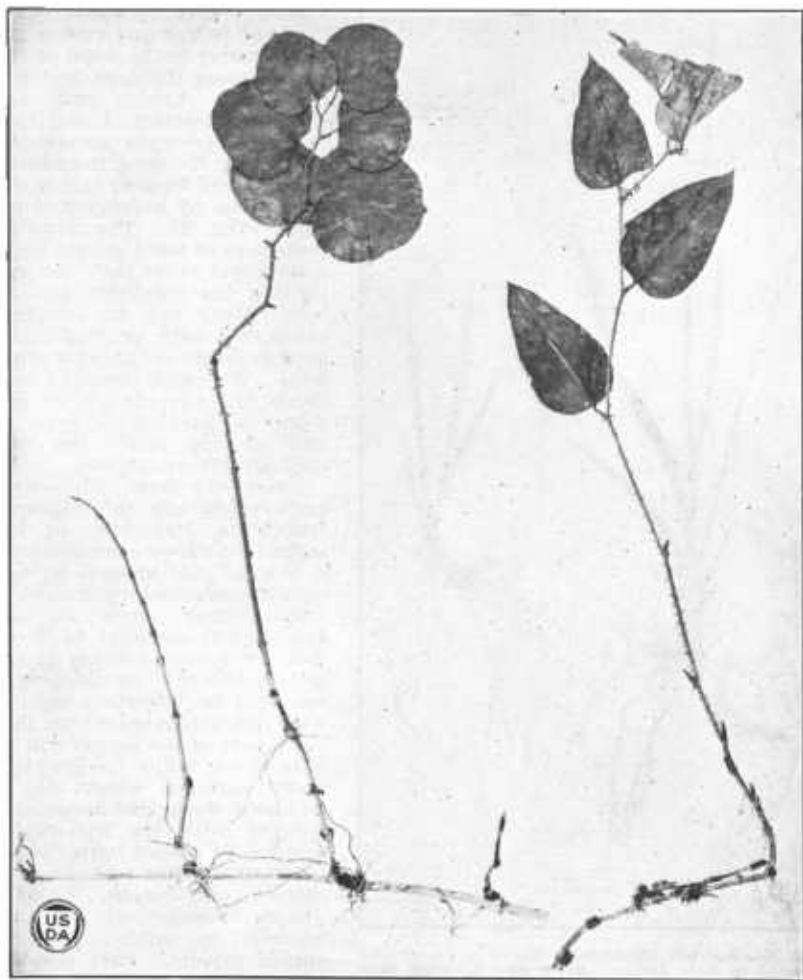


FIG. 7.—Greenbrier, cat brier, or horse brier. To the left is the round-leaved greenbrier (*Smilax rotundifolia*); to the right the lance-leaved form (*S. glauca*). Both are bad weeds in cranberry fields and are controlled by digging out the roots or by continued treatment with sulphuric acid.

after growth starts in the spring before the cranberry buds have opened. Nitrate of soda used at the rate of 150 pounds per acre reduces this moss and promotes cranberry vine growth at the same time.

Poison ivy (*Rhus toxicodendron*).—This is seldom a serious weed in cranberry fields except in New Jersey, and there it is serious mainly because it poisons the pickers and other workers. It spreads by means of underground rootstocks, mostly from neighboring upland. If border ditches are kept clean little trouble will be experienced, but if established it must be grubbed out or killed with sulphuric acid.

Redroot or dyeweed (*Gyrotheca tinctoria*).—This perennial herb has been considered a serious weed of cranberry fields in New Jersey because of its wide-spreading rootstocks which make new plants. Vigorous-growing cranberry vines, however, will crowd it out, and under ordinarily good conditions it is not troublesome. Pulling has been the common method of control (fig. 8).



FIG. 8.—Redroot (*Gyrotheca tinctoria*), a serious weed in New Jersey. It is now believed that by giving the cranberry vines the best of care this weed will be crowded out.

Golden-crest (*Lophiola americana*) resembles redroot and its control is the same.

Sedges and rushes.—Many kinds of sedges and rushes grow in cranberry fields, some of them being among the most serious of the weeds. Cotton grass (*Eriophorum virginicum*) and three-square (*Scirpus americanus*) are among the most troublesome. They spread by seed and to some extent also by underground rootstocks (fig. 9). The roots and rootstocks of some species occupy a soil layer lower than that occupied by the cranberry root system. Many can be completely eradicated only by digging, but good drainage and mowing always help. Wisconsin growers sometimes kill out certain of these plants by holding the flood late and mowing under the water such growth as appears.

Among the more serious sedges and rushes are the following: Dulichium, star-grass, or leafy sedge (*Dulichium arundinaceum*) is a weed that spreads by seeds and underground rootstocks, becoming very dense in spots. Drainage is essential to its control. Frequent mowing or pulling is effective in checking its spread. In Wisconsin spraying with iron-sulphate solution in the early part of the season will hold it in check, while the growth on badly infested areas may be trampled down and immediately sprayed with the iron-sulphate solution or dusted with the powdered form. Bog rushes (several species of *Juncus*, especially *Juncus canadensis*) are very common on sanded fields and spread rapidly. They should be mowed above the vines to prevent seeding until the latter crowd them out. Good drainage

helps to control them, and in Wisconsin iron-sulphate sprays applied at 10-day intervals during the early part of the season help to check their growth. Bunch-grass, leafy bulrush, or bull grass (*Scirpus polyphyllus*) is a rank-growing perennial sedge with slender stalks. Young plants are easily pulled, but well-established plants must be cut out with an adz, or with a special 3-cornered hoe made by cutting away parts of the blade of a large garden hoe and sharpening the edges. Cut-grass (*Carex bullata*) propagates by seeds and coarse rootstocks, and the growth may become very dense. The leaves are coarse and their edges cut the hands of pickers, who dislike to harvest the crop where it is present. Large, badly infested areas should be rescalped. Small infested areas

should be drained and may be weeded by using one of the tools shown in Figure 4. Frequent mowing in the early part of the season will hold it in check. Three-square (*Scirpus americanus*; fig. 7) is one of the sedges which propagates by seeds and rootstocks. Its control is the same as for *Dulichium*, or star-grass. Virginia cotton grass (*Eriophorum virginicum*) is a wet-land plant which propagates by seeds and underground rootstocks, producing large tufts of cottony seed masses in the fall. After the seed masses have been blown off the leaves turn a reddish brown. Its control is the same as for *Dulichium*, or star-grass. Wire-grass (*Carex oligosperma*) is a common weed of unsanded or poorly drained peat fields. Pulling is hardly practicable, but drainage is essential. One to three mowings just above the cranberry vines in early summer prevent it from seeding and check it so that vigorous vines will crowd it out. Along the ditches it is controlled by frequent pulling or mowing until the vines are well established. If necessary, the edge of the ditch can then be cut off to remove the grass.

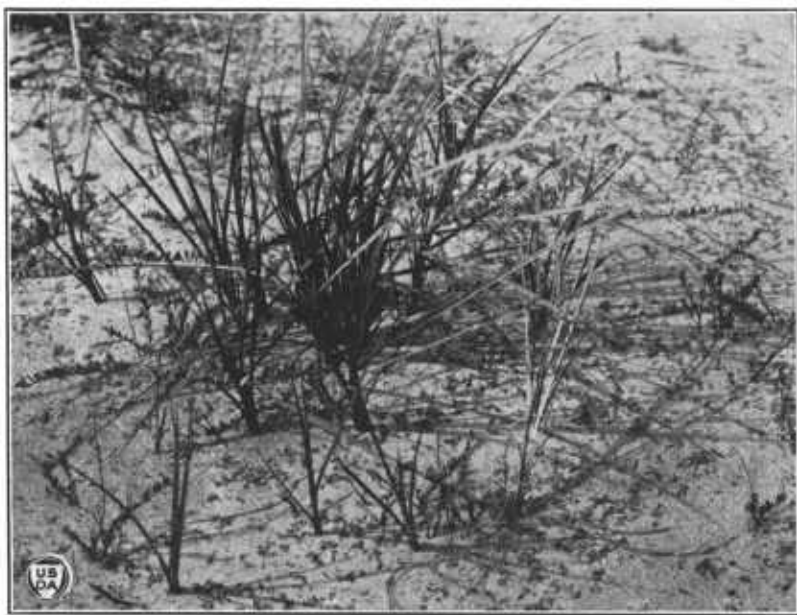


FIG. 9.—Sedges in a cranberry field, showing the young plants which have grown from the original plant in the center. Sedges crowd and shade the cranberry vines, and their roots grow in a soil layer below that which the cranberry roots occupy. They are more common on fields kept too wet than elsewhere, and they are often controlled by draining.

Sweet fern (*Comptonia peregrina*; also known as *Myrica asplenifolia*).—Occasionally a serious weed in New Jersey. It is controlled by grubbing.

Three-leaf bogbean (*Menyanthes trifoliata*).—A Wisconsin weed. The wide-spreading thick leaves on coarse runners shade and crowd the cranberry vines. Treatment as for *Dulichium*, or star-grass, is recommended.

White cedar (*Chamaecyparis thyoides*).—A weed chiefly in New Jersey where seed trees are allowed to grow on near-by land. Cut out seed trees and pull seedlings in the field. (See fig. 5.) Seedlings are easy to pull the first season.

Willows.—In Wisconsin fields certain willows become serious weeds if not pulled out when they first appear (fig. 10).

CLEANING DITCHES AND UPLAND.

Every few years all ditches must be cleaned. Sand and mud wash into them and growing weeds help to fill them, thus impairing the drainage.

To protect the field against forest fires, to destroy weeds, and to make picking more convenient, the adjacent upland should be mowed each year.

PRUNING.

Cranberry vines are pruned to cut runners that might interfere with scooping, and sometimes to thin out vines. Under ideal conditions on established fields the uprights make an annual growth of 1 to 3 inches. Full crops may then be produced and little or no pruning is necessary. Maximum pruning is needed on fields with rich bottoms where long runners abound.

The first pruning should be done after the first picking with scoops. The vines grow in all directions, and to avoid pulling many vines loose this first crop should be harvested with a picking device called a "snap," though in Wisconsin it is nearly always hand picked. To make it possible to use snaps and scoops easily thereafter without damage to the plants cross runners should be cut, and all those not cut should run in one direction—that in which the pickers must thereafter go when scooping. Loose vines are first raked off the field, as shown in Figure 11. Pruners follow after those raking the loose vines.

Figure 12 shows the type of pruning rake commonly used. Horserakes with knife teeth are occasionally used, but careful work can not be done with them.

MOWING AND BURNING.

Sometimes the vines become dense, clumpy, and tangled. Growers often burn or mow such areas in the dormant season.



FIG. 10.—A willow seedling (*Salix interior*). This is often a serious shrub in Wisconsin cranberry fields and must be grubbed out.

Burning may be more economical, but mowing probably is preferable. A fair crop often is secured the second year after mowing, and the third year a full crop may be expected.

Figure 13 shows an area where too rapid growth has been made and the uprights are 18 to 24 inches long. Little fruit is produced under these conditions. This area should be mowed.

When areas become badly infested with certain insect pests, growers sometimes feel that it pays to renew all the vine growth by burning, at the same time destroying the insects. The burning is done from November to April, inclusive, either with the ground frozen or with the water table at the surface. Burning should not



FIG. 11.—Raking off torn and broken vines after harvesting. Photographed October 13, 1917, at Walker, Wis.

be done when the ground is dry, for it may kill the cranberry roots. A full crop is expected the third year after burning.

DURATION OF A CRANBERRY FIELD.

Properly constructed fields are practically permanent. Only because of injury by insects, by winterkilling, or in some other way do they ever need to be replanted. Growers sometimes scalp and replant fields that were planted to unprofitable varieties, but they rarely replant profitable areas. The cost of replanting a field and caring for it until it comes into bearing is too great to make the practice common. Actual records show that the cost of replanting and again bringing the field into bearing has been \$500 to \$800 per acre.

Figure 14 shows one of the first fields ever planted. Figure 15 shows another field near by with its first crop being harvested.

SEASONAL OPERATIONS IN CRANBERRY FIELDS.

The operations in a cranberry field may be summarized briefly as follows:

January, February, and March.—Watch the winter flood, letting off water when it becomes too deep and letting it on when too shallow. Repair breaks in dams and dikes. Resand on ice when practicable and when needed.

Clean separators and houses and repair scoops and boxes.

April.—Remove winter flood except where fruit worm is serious. Repair head gates. Resand if it is necessary.

May.—Remove winter flood if this was not done in April. Reflow whenever freezes occur or frosts threaten after growth starts, and in New Jersey reflow to control the blackhead fireworm. Continue repair work. Begin weeding if season is early.

June.—Reflow to control blackhead fireworm and other pests. Do all weeding possible. Spray to control insect pests when it is necessary. Spray in



FIG. 12.—Pruning rake used to cut runners in cranberry fields. Knives are used in place of the teeth of an ordinary rake. The runners are cut so that scoops may be used in harvesting. This tool often has been used much too freely.

New Jersey for early-rot just before the blossoms open. Mow upland and dams.

July.—Apply second spray for early-rot in New Jersey when the blossoms fall, and again two weeks later. Spray to control insect pests when it is necessary. Continue weeding fields and mowing upland.

August.—Overhaul pump engine. Engage pickers and screeners. Improve roadways in preparation for harvest.

September.—Pick all early varieties, beginning early in the month. Flood for frosts only when absolutely necessary. Reflow picked fields for two weeks, starting during the last week of this month.

October.—Pick the late varieties before the middle of the month. After picking rake off loose vines. Prune where necessary. Begin resanding if this is needed where sanding on ice is not practicable.



FIG. 13.—Vines of the Howes variety on very rich peat. Note that the uprights much exceed the height of the foot rule. Such areas should be mowed or burned over.

November and December.—Continue resanding. Put on winter flood in Wisconsin from November 15 to 30; in Massachusetts and New Jersey in December.



FIG. 14.—A cranberry field, one of the first to be made, still in good condition after bearing for 70 to 80 years. Photographed at Pleasant Lake, Mass., September 27, 1917.

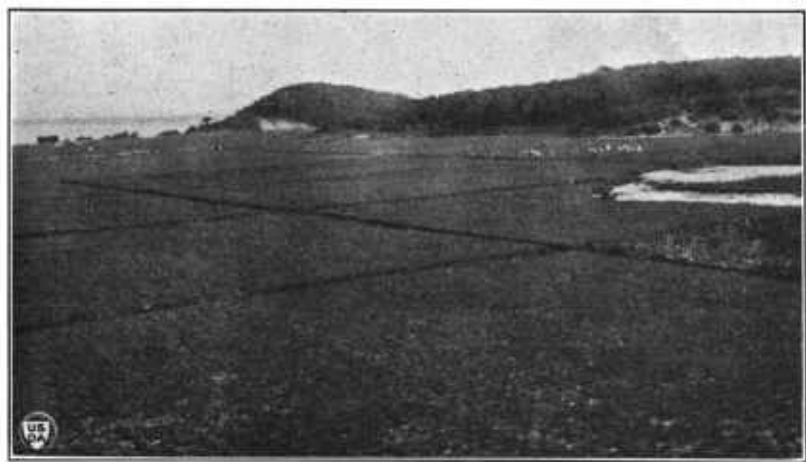


FIG. 15.—New cranberry field at Pleasant Lake, Mass., located near the field shown in Figure 14. Note the sand banks in the background at the left and right. Photographed September 27, 1917.